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AGRICULTURAL RESEARCH IN NEW HAMPSHIRE

Annual Report of the Director of the New Hampshire Agricultural Experiment Station for year 1930

University of New Hampshire
Durham, N. H.

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AGRICULTURAL RESEARCH IN NEW HAMPSHIRE, 1930

Report of the New Hampshire Agricultural Experiment Station

J. C. KENDALL, *Director*

In a period of economic depression such as we have been going through for the past year the importance of research work becomes even more obvious. There must be a body of reliable information on which to base decisions; and without such information, we are more likely in times of stress than ever before to be washed away from our moorings.

Especially valuable is it to have data on economic phases. Questions on costs of production, on marketing, on land utilization, on farm management, on cooperative finance come to the fore. And the agricultural experiment stations of the country are convinced that the economic studies, made possible by the Purnell legislation, have come none too quickly.

In this connection it may be well to point out that agriculture as a whole pays much less for research than do other important industries of the country. According to a pamphlet issued by the Division of Engineering and Industrial Research of the National Research Council, expenditures for research made by millionaire manufacturing companies in the United States averaged about $13 for each $1,000 capital invested. Included in the list were automobile, chemical, food, steel, leather, lumber, metal-working, paper, rubber and textile industries. On the other hand the survey of land-grant colleges and universities recently made by the United States Department of the Interior indicates that the expenditures of state and federal agencies for agricultural research amount to about 43.5 cents for each $1,000 of capital invested in agricultural production. Industry is about 30 times as solicitous as as agriculture for research, according to these figures.

Among important new projects recently started were a wholesale milk farm study in the Woodsville-Haverhill area and studies of the time of cutting hay. All told, 77 projects are now in process of investigation. Significant results during the year are reported in the following pages.

New publications were issued during the year as follows:

Bulletin 245—Inspection of Commercial Feeding Stuffs 1929.
" 246—Results of Seed Tests for 1929.
" 247—The White Pine Weevil in New Hampshire.
" 248—Inspection of Commercial Fertilizers for 1929.
" 249—Roadside Marketing in New Hampshire.
" 250—Agricultural Experiments 1929.
" 251—Operating Costs of Retail Grain Stores in New Hampshire.

Circular 30—Vaccination for Fowl Pox.
" 31—The Horse Situation in New Hampshire.
" 32—Surface Areas of Sheep.
" 33—Hopper-Feeding Grain.
" 34—Electric Laundry Equipment on the Farm.

Technical Bulletin 39—Surface Tension, Surface Activity, and Wetting Ability as Factors in the Performance of Contact Insecticides.
" " 40—Lime Sulphur in Relation to San Jose and Oyster Shell Scales.
" " 41—Some Effects of Defloration on Fruit Spur Composition and Fruit Bud Formation in the Oldenburg Apple.
" " 42—Composition and Fruit Bud Formation in Non-Bearing Spurs of the Baldwin Apple.
" " 43—The Energy Metabolism of Sheep.

Scientific Contribution 24—Effect of Size of Seed Used in Commercial Planting on the Incidence of Leaf Roll and Mosaic in Potatoes.
" " 25—Experiments on the Control of Mustard.
" " 26—The Period of Blossom Bud Differentiation in Baldwin and McIntosh Apples.
" " 27—Effect on Plants of Cyanide Fumigation Following Spraying with Bordeaux Mixture.

Press Bulletin 2—Trapping Codling Moths to Determine When to Spray.

There were few changes in personnel during the year. R. B. Dearborn was appointed assistant in vegetable gardening; A. E. Tepper, assistant poultryman in charge of certification work; F. E. Perkins, editorial assistant; and Samuel Hoitt, Neil Stuart, S. J. Fisher and L. S. Groves as graduate assistants.

Pastures Respond to Treatment

That the better areas of permanent pasture in New Hampshire will respond profitably to fertilizer treatments is shown by the results from a series of plots in 22 pastures of the state where studies were conducted by F. S. Prince, P. T. Blood, and G. P. Percival.

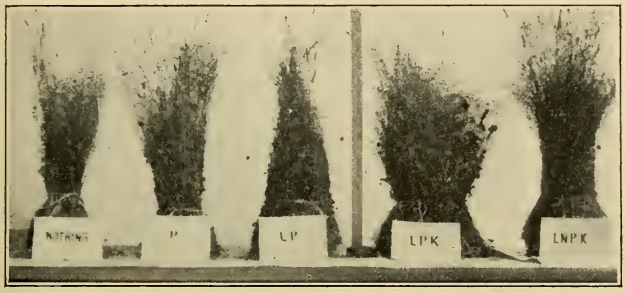
Even though poverty grass and other undesirable plants may be present, supplying plant food tended quickly to stimulate Kentucky blue grass, bent grasses and, on the heavier soil types, white Dutch clover, crowding out the undesirable species.

On the lighter soil types where there is little or no Dutch clover, the results indicated that it is better to start with an application of complete fertilizer in sufficient quantity to take care of the nitrogen requirements of the sod for that season and of the phosphorus and potash requirements for three or four years, following this up each spring with an application of 200 or 300 pounds of nitrate of soda, or its equivalent, per acre.

This means an initial application equivalent to from 300-500 pounds of a 10-16-14 or the same quantity of an 8-16-16 fertilizer per acre.

If fertilizers are used early in April according to this schedule, the date of turning the cows into the pasture will be hastened, and more feed will be produced during the summer months. The pasture season is not only lengthened, but the quality of the feed is enhanced due to the higher protein content of the grass produced.

Pastures which carry considerable white Dutch clover, should receive the same initial application of fertilizer if early feed is needed by the herd. Sufficient land may be top-dressed in this manner to meet the needs of the animals during the early summer. This probably means



Yields of square-yard areas of pasture given different fertilizer treatments in May, 1929. The grass was cut August 2, 1929. From left to right the bundles represent the use of no fertilizer; phosphorus; lime and phosphorus; lime, phosphorus, and potash; lime, nitrogen, phosphorus, and potash.

an acre for two or three cows. Top-dressing too large an area of mixed grass and clover with fertilizers carrying nitrogen in their make-up may so stimulate the grass that, if uneaten, the clover will be crowded out.

On other areas and if additional feed is not required through May and June, results indicate that these clover pastures may be best top-dressed with phosphorus and potash at the rate of 500 or 600 pounds of 16 per cent super-phosphate and 200 pounds of muriate of potash per acre. This application will need to be repeated not oftener than once every three years, and on such areas should increase the fall feed to a considerable extent and make the pasture better throughout the season in succeeding years.

Results of the experiments are reported in detail in Station Circular 35. (*Purnell Fund*)

Perspiration a Factor in Animal Metabolism

Wide variations in the amount of water given off through the lungs and skin of dairy cows are found in the studies conducted by E. G. Ritzman in cooperation with F. G. Benedict of the Carnegie Institution of Washington, D. C.

Even on maintenance, water lost by insensible perspiration is from two to three times greater than the amount passed in the urine.

The results so far obtained suggest a compensating arrangement between these two methods of eliminating water from the body from day to day. Normally the water passed as urine, on a uniform feed level and under fairly uniform temperature conditions remains fairly uniform, but the insensible loss of water under like conditions may vary as much as 12 or even more pounds. However, when there occurs a sudden drop in temperature the insensible drops likewise and more excess water is eliminated as urine.

A practical object of this study is to determine the possible inhibiting effect of changes in water loss by insensible perspiration on milk yield and its partial control by blanketing. (*Purnell Fund*)

Higher Energy Value Found for Alfalfa

Studies on the net energy value of various rations and on individual feeds were also made in the nutrition laboratory by means of measuring the metabolism or energy reaction of the animal to a given amount of food consumed. The results, for timothy hay and linseed oil meal, compare very well with results obtained from a seven-months' feeding experiment computed on basis of Armsby's net values, and conducted by E. B. Meigs, Bureau of Dairying, United States Department of Agriculture. They suggest, therefore, that Armsby's net energy values for these two staple food products—timothy hay 43.0 therms, and linseed oil meal 89.9 therms—are correct, particularly since they were obtained by three different methods of technique.

With alfalfa hay on the other hand a net energy value of 49.6 therms per 100 pounds hay was obtained which is materially higher than the amount (34.2 therms) given by Armsby but again closely corresponds to the results obtained by Meigs from feeding a maintenance ration of alfalfa over a period of seven months. Several similar measurements of net energy value of corn meal were also made during the year but these will be repeated in order to check the results. (*Purnell Fund*)

Metabolism Studies with Sheep

Sheep need more food for mere existence than has heretofore been supposed, according to experiments conducted in respiration chambers by E. G. Ritzman in cooperation with F. G. Benedict, of the Nutrition Laboratory of the Carnegie Institution. Results of over 200 separate tests indicate that an adult sheep requires from 28 to 35 calories per kilogram of weight each day to maintain its bodily requirements. In lambs the energy draft runs much higher still, amounting to about 100 calories at two weeks of age as compared to 74 for calves.

The work was reported in Technical Bulletin 41 and at much greater length by Wissenschaftliches Archiv Fur Landwirtschaft, Abt. B., Tierernahrung und Tierzucht, Berlin, Germany.

Sheep reach maturity at a much earlier age than the larger domestic animals such as horses and cattle, and they make a much greater proportion of their total growth during the suckling stage. Hence the metabolism is apparently high in proportion with the faster growth rate. By the end of the fourth month of life their energy requirements reach a level below which there is only a relatively small further decrease. (*Adams Fund*)

Electric Laundry Equipment Tested

Since no group of electrical appliances is in such general use as the equipment for laundry work, special studies of current consumption and other factors were made by W. T. Ackerman on the seven electrical experimental farms.

All washing machines and flat-irons, both old and new, were considered essential equipment and performed to the satisfaction of all users from the standpoints of efficiency, cost of operation, character of work done and freedom from mechanical or electrical difficulties.

Electric flat irons on the experimental farms used an average of $3.28 worth of current per year. Four of the farms tried electric ironing machines.

Ironing machines proved successful and desirable to three users and not essential in the fourth case.

Washing machines consumed an average of 30 Kwhs. per year, with a corresponding average operating cost of $2.94. Estimated depreciation and current charges together amounted to $21 per year.

The current used by flat irons averaged 83 Kwhs. per year with a corresponding average operating cost of $3.28.

Ironing machines were found to use an average of 109 Kwhs. per year with a corresponding current cost of $4.51. Depreciation costs were estimated to exceed current costs about three to one on this appliance. Ironing machines practically eliminate the use of hand-irons where the two are used together, for the reason that the larger machine will do more work in one-third to one-half the time with less fatigue.

More detailed data is given in Station Circular 34. (*Miscellaneous Income*)

Milk Cools Best in Dry Storage

Further studies in milk cooling conducted by W. T. Ackerman and H. C. Moore point to the superiority of the dry room or cabinet type of electric refrigeration over the wet tank type of storage. Under the former method surface coolers are used for pre-cooling the milk before it is placed in storage; under the wet type pre-cooling and storage are combined into one process by immersing cans of warm milk in refrigerated water.

The significant findings to date show that:

The total number of points of contamination are much fewer in number for the dry method than for the wet. The rate of cooling in the dry process is almost instantaneous as compared to several hours for the wet tank. The final bacteria count of milk is invariably higher in the wet-tank method, due to the slow cooling process which allows rapid multiplication of the original bacterial content acquired through the milking and handling process.

The contamination factor of surface coolers is no greater, and generally not so great, as that of many other utensils used in the milk-handling process. This, after all, is a matter of cleaning and sterilizing utensils rather than a factor of refrigeration equipment; and a good percentage of the coolers tested under actual farm conditions have shown a high degree of cleanliness.

It seems evident that if the milk contains less than 5,000 bacteria per c. c. at the time the cooling operation starts, any of the various approved methods of cooling milk to below 50° F. and holding below this temperature, will insure desirable quality milk (from a bacterial standpoint).

As an example, a 40-quart can of milk which required 1½ hours to cool to 50° F., and 4½ hours to reach 40° F., was delivered at the latter temperature to a milk receiving station 15½ hours after production. It contained only 500 bacteria per c. c.

A can of milk cooled on a different farm using the same method, but containing 75,000 bacteria per c. c. at time of production, increased to 245,000 bacteria per c. c. in the 16 hours the milk was left on farm.

Where the practice is followed of using a surface cooler, with well water as a cooling medium, and with cans placed in dry storage, the bacterial increase during 12 hours' storage may be as low as 8 per cent, and it may be as great as 610 per cent.

The initial contamination of the milk was found to be due in most cases to dirty milking machines, dirty cans, and dirty cows. In one instance, had a certain 40-quart can been filled with milk, it would have added 81,000 bacteria to each c. c.

Bacterial counts taken on milking machines as soon as the machine was removed from the cow showed counts ranging from 100 to 570,000 bacteria per c. c. (*Purnell Fund*)

Costs of Retailing Grain

Grain store credit costs approximately double that of banks. Cash customers at such stores doing a credit business pay for a service they do not obtain, according to the study by E. H. Rinear of operating costs of retail grain stores in New Hampshire. Further highlights of the work which is published in Station Bulletin 251 are as follows:

The cash price of corn becomes higher as the percentage of credit sales increases in a retail store. Grain prices shifted less than 15 times during the same year that the Boston wholesale market price changed 40 times. Store prices lagged an average of 2.6 weeks as the market moved upward and 4.8 weeks when it went downward.

An average of $870,500 was carried in accounts and notes receivable by 89 grain stores. The average turnover of accounts receivable was 38 days. Bad debts ranged from none up to $4,000 per store.

The average inventory turnover was 10.2 times in a year. As the number increased an average of three times, total costs decreased 1.7 cents per dollar of sales.

When weekly retail cash-store prices for grain and feeds of the same standard or brand were compared at 62 stores, a great range in prices was found. The largest range was 65 cents per hundred for wheat and the smallest 30 cents per hundred for middlings.

The number of employees per store averaged 3.7 persons. As yearly sales per man increased from less than $20,000 to $60,000, labor costs decreased two cents, total costs six cents, and gross margins five cents per dollar of sales. The stores operated by one man had a higher average of sales per hour of occupied time than those operated by three or more people.

The business of 41 grain stores was transacted on a gross margin of 11.22 per cent of sales and a net profit of .46 per cent. Fifteen per cent of the feed and grain sold by the grain stores of the state was marketed

On this farm they are saving labor, one of the greatest costs in fruit growing. The year before this picture was taken, three men did this spraying job.

direct from the car door, 62 per cent at the store, and 23 per cent delivered to the customers. (*Purnell Fund*)

Orchard Costs Investigated

Each 1,000 boxes of apples in 12 southern New Hampshire orchards cost an average of $322 before harvest for labor, equipment and materials, according to estimates following a three-year fruit-farm study, the results of which are now being arranged for publication in bulletin form.

Approximately 42 per cent of this pre-harvest expense was for man labor; 9 per cent for horse, truck, and tractor labor; 24 per cent for fertilizer; 21 per cent for spray material. A deduction is that the greatest single farm-management problems concern labor. This has led to two questions: How much work should be done on each orchard operation? How can this be done most efficiently?

Results suggest that some orchardists are putting much more time on each operation than others. One group may be said to be intensive orchardists, forcing production to the limit with extra labor, while the other group are extensive orchardists, using proportionately less labor per operation. The latter may get less production per tree or per dollar invested, but their returns per man hour are greater.

Two of the 12 orchardists may not be doing enough work to maintain their orchards in a healthy bearing state, while three others seem to be putting intensive labor on certain operations beyond the point of diminishing returns. In these cases and to some extent on the other farms, the men need to give consideration to the amount of work done and to the best methods of doing it.

Spraying, including labor, material, and the use of sprayer, represents 36 per cent of the current operating costs prior to harvest. Need for more of it in the future seems certain. It will, therefore, become of more relative importance as to cost.

An interesting comparison of cultivated and uncultivated orchards was revealed in the investigations. About 15 per cent of the total acreage was cultivated, at an estimated cost of $16.36. The cost of mowing and mulching in uncultivated orchards was $3.30 per acre.

H. C. Woodworth and G. F. Potter have had charge of this research. (*Purnell Fund*)

Tomato Crosses Studied

Larger yields of tomatoes are indicated from crosses of standard stocks as compared with pure parent strains, according to experiments conducted by J. R. Hepler. A series of trials involving 70 plants of each parent and cross was made in the greenhouse with five varieties, viz. Bonny Best, Earliana, Ponderosa, Dwarf Champion and Sunrise.

Sunrise, a very small but vigorous-growing and free-setting English greenhouse tomato, was the only variety which tended to yield as well as its crosses. The Ponderosa crosses showed up the best. It is expected that data on this and other tomato breeding experiments will be published shortly. (*Hatch Fund*)

The Force Behind Fruit Buds

What happens in that mysterious growing area at the tip of a fruit spur when a bud which might have produced a leaf decides to produce a flower instead—and so probably an apple?

This question has been the subject of one of the Station's most extensive investigations; and the study was materially advanced last year by the publication of two new technical bulletins.

The first of these, by Messrs. G. F. Potter, H. R. Kraybill, S. W. Wentworth, J. T. Sullivan and P. T. Blood, showed that a fruiting spur materially affects its neighbor spurs. Chemical composition and fruit bud formation is altered by its presence; and many deductions made previously by some authorities must accordingly be thrown out of court.

This work was followed up by G. F. Potter and T. G. Phillips in a comprehensive series of experiments which avoided spurs of complex relationship. Isolating non-bearing spurs, they studied fruit bud origin

in its purer and simpler forms. Their findings contradict previous theories that starch is the determining factor among the chemical constituents of a spur. True, large quantities of starch were invariably found, but the focal point was located in the degree of nitrogen content. Insoluble nitrogen proved most consistently associated with blossom formation. Whether nitrogen alone or the relationship between nitrogen and starch is the principle cause of fruit bud formation is not yet clear. (*Adams Fund*)

Here is pictured the familiar "nitrate ring." Research thus far shows that the so-called "complete fruit fertilizer" is not superior to material containing an equivalent amount of nitrogen.

Late Nitrate in Orchards

Orchard fertilizer experiments, conducted by G. F. Potter, do not yet indicate the advisability of anything more than the spring application of nitrogen alone.

Divided applications of nitrogen have been made in four test plots for several years. It was thought originally that differences in growth and productivity of trees would result from second applications made in June or July; for previous soil studies had shown that nitrates applied in early spring have disappeared completely from a sod soil by midsummer. The results to date seem to indicate, however, that the delayed applications merely add to the nitrogen reserve in the tree and are carried over to the succeeding spring.

In response to popular demand, experiments were begun in the spring of 1930 to determine whether a so-called complete fruit fertilizer is of greater value under New Hampshire orchard conditions than materials containing an equivalent amount of nitrogen. Trials were begun in an

11-year-old cultivated McIntosh section of the University orchards and in a mature commercial Baldwin orchard at Wilton, N. H. During this, the first season, the McIntosh trees receiving complete fertilizer produced 226 pounds of fruit per tree while those receiving only nitrogen produced 241. In the Baldwin orchard the trees receiving only nitrogen produced 585 pounds, while those receiving the complete fertilizer produced 386. Considering the fluctuation between individual pairs neither of these differences can be considered significant.

Recent evidence from various sources indicates that phosphorous and potash tend to become fixed in most soils before they can reach a depth at which they would be available to the feeding roots of an apple tree. Experiments have recently been reported from the California Experiment Station in which surface applications of potash were of no avail, but materials in solution forced down in pipes to a depth of three feet have benefited prune trees in certain respects. This offers a plausible explanation of the failure to obtain results from surface applications of complete fertilizer on New Hampshire orchards. It may be added, however, that under ordinary soil conditions in this secton apple trees do not exhibit the indications of lack of sufficient potash which have been observed in apple orchards in England.

In the Woodman Orchard, where nitrogenous fertilizer has been compared with nitrogen and phosphorus since 1929, a special effort was made to plow the phosphorus deeply into the soil and then by seeding down to allow the feeding roots of the tree to enter the area in which the phosphorus had been incorporated. The yield in 1930, the second year of the experiment, is slightly in favor of the trees receiving phosphorous, but again the difference is scarcely significant considering usual sources of variation in yield within an orchard.

Precooling Helps Keep McIntosh

The eating season for McIntosh apples can be kept open 'till the following summer by means of cold storage, finds E. J. Rasmussen in a series of storage tests. For keeping up to Christmas, common storage proves best, since it gives the apples a chance to ripen up. From January to June, however, cold storage at 30° proved most satisfactory as far as firmness is concerned and at 32° where flavor is considered.

Pre-cooling, *i.e.*, getting the apples down to 30° temperature as soon as possible, was found to improve considerably the keeping quality. There should not be more than five days from tree to storage for successful handling, however.

No difference in keeping quality of McIntosh from different orchards could be detected, even though one lot was from a sod orchard and another from a cultivated one. With Baldwins there was a fairly marked difference. Ground color—the green or yellow undercolor of an apple—and pressure test are not always an indication of the best keeping quality in Baldwins.

Losses in weight in cold storage were insignificant. During the usual storage period, November 1 to June 1, the average loss was from 1¼ to 2½ pounds per box. In common storage loss in weight was at the same rate up to March 15th. (*Purnell Fund*)

Lancaster Lettuce Started Well

The experiment to determine whether "Iceberg" lettuce can be successfully grown on a commercial scale in the White Mountain area of New Hampshire met with auspicious results early in the season of 1930; but an unusual spell of sunless weather coupled with a flooded market changed the story. The first shipments of lettuce from Lancaster, where ten acres were grown experimentally by the Station, under the charge of R. B. Dearborn, were of fine quality heads, solid and free of dirt. Prices were comparable with those for western "Iceberg".

One wholesale distributor purchased a lot of lettuce and placed it in his storage along with some western. After five days had elapsed, he checked on the lettuce from the two sources and stated, "That from New Hampshire held up equally as well as the western and the flavor was better." Subsequent shipments declined in solidity; and also in quality, due to wet cloudy weather.

A trial carload of "iceberg" lettuce shipped from the experimental plots at Lancaster.

Until further trials have been made, the Station is not ready to recommend commercial culture of the crop; but on the other hand, is not yet ready to abandon the project.

Effect of Temperature on Seed Stalk Formation. Greenhouse studies with lettuce prior to the outdoor experiment reported above indicated that the growth of seed stalks is directly proportional to the amount of heat.

Fertilizer studies with Lancaster soil under greenhouse conditions showed marked results from the use of acid phosphate in promoting growth. A combination of medium nitrogen and high phosphorus gave best returns, and in the commercial plantation a 5-8-2 fertilizer was used. (*Purnell Fund*)

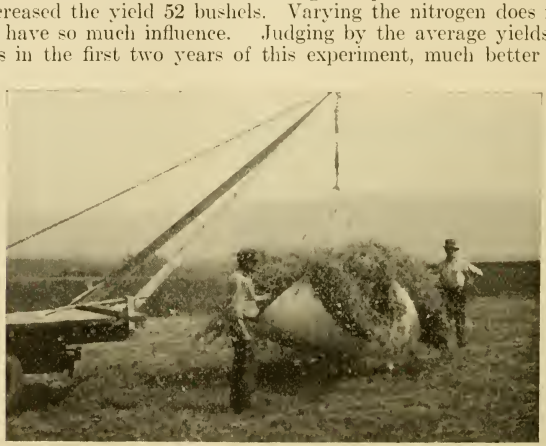
Soil Fertility Studies

The Station's long-time soil fertility experiments, involving 461 plots on five different areas in the state, are building up a body of evidence as to varying treatments, particularly on run-out soils.

In the grass plots at Greenland, where the original sod plots, badly run out, were not plowed, nitrate of soda has failed to give the significant increase which it gave on the plowed sections, whether manured or not. Superphosphates failed to give a significant increase when used

alone on these plots. Lime, both in two-ton and four-ton applications, showed significant yields. After another season's work on these plots the results for a five-year period are to be published in bulletin form.

In the potato plots at Colebrook phosphorus has proved thus far a sensitive element. Leaving it out of the formula depressed the yield 85 bushels per acre, while doubling it over the regular 5-8-7 formula increased the yield 56 bushels per acre. More response was obtained for varying the potash than in the previous year. Leaving potash out of the formula depressed the yield 115 bushels per acre and where lime was introduced 178 bushels. Increasing the potash from 7 to 10 per cent increased the yield 52 bushels. Varying the nitrogen does not appear to have so much influence. Judging by the average yields of the potatoes in the first two years of this experiment, much better returns



This method was used in weighing the yields on fertilizer test plots.

might be expected from one ton of a 5-16-10 fertilizer than from 1½ tons of a 5-8-7. (*Purnell Fund*)

Variety Tests

A comparative trial of straight seedings of white Dutch and Ladino clover on the Carter form at Boscawen indicated that the Ladino, a giant variety of white Dutch, outyields the white Dutch 22.7 per cent.

Trials of prominent strains of flint and dent corn now being grown in New Hampshire were also made at Boscawen, together with a very early strain of flint corn developed for northern Wisconsin conditions. Yields showed the following results from four-row plots after reducing to the same moisture content: John Hutchins, Carroll, 40.3 bushels; Charles Cotton, Strafford, 35.9 bushels; Mrs. Ida M. Bell, Coos, 33.8 bushels; Fred A. Roy, Cheshire, 33.6 bushels; Fred W. Smith, Sullivan, 33.3 bushels; A. B. Locke, Strafford, 33.2 bushels; J. D. Porter, Sullivan, 32.7 bushels; Charles Thompson, Carroll, 32.6 bushels; Wisconsin

Experiment Station, Wisconsin, 30.1 bushels; Lawrence Wadleigh, Rockingham, 29.4 bushels; George Mansfield, Hillsboro, 27.2 bushels.

Trials of oats and annual legumes showed the following yields per acre in air-dry weight: Oats and hairy vetch, 4,544 pounds; oats and spring vetch, 5,013 pounds; oats and peas, 5,749 pounds; Wilson soy beans, 2,517 pounds; Manchu soy beans, 2,571 pounds; Wilson soy beans and Hungarian, 4,085 pounds; Wilson soy beans and Japanese millet, 3,565 pounds; Wilson soy beans and Sudan grass, 2,906 pounds.

Early Cut Hay Gives More Protein

To what extent does the date of cutting hay affect the amount of protein per acre? In an attempt to answer this question quadruplicate plots of hay land were laid out on the University farm, were not top-dressed and were harvested at ten-day periods beginning June 10. After each harvest the hay from the plots was transported to a drier, especially constructed for the purpose, and evaporated to an air-dry basis.

Hay cut June 10, when the heads were appearing, had the highest percentage of protein. The greatest yield of protein per acre came June 30, while the heaviest yield of hay per acre was obtained on July 10. After this date the total yield decreased slightly, while the yield of protein per acre fell off rapidly after June 30.

The findings of the first harvest and of the second, conducted on all plots September 2, indicate that a farmer in southern New Hampshire is justified in haying in time to finish before July 1 instead of waiting for that as a starting date. (*Hatch Fund*)

Roughage Production Costs

Reduction in the number of men used at silo-filling time has been especially noticeable during the investigation of roughage-production costs in New Hampshire by M. F. Abell. He finds it quite common now for farmers to dispense with the man in the silo and the extra man at the cutter and with the help of low and special racks, to reduce the high labor cost of filling silos.

He has obtained 225 silage records and 245 hay records and expects to increase the number of each to 300. A check on the survey records will be supplied by 12 detailed silage records and eight detailed hay records. (*Purnell Fund*)

Potato Marketing

If potato growers in southern New Hampshire wish to compete with the better producers in Coos county, they must obtain yields of at least 250 bushels per acre, according to potato-marketing studies by E. H. Rinear and M. F. Abell. On the basis of 300 bushels and 200 bushels for northern and southern New Hampshire respectively, the Coos-county grower would net at least $25 more per acre at a price of $1.50 per bushel to the consumer.

During the fall of 1930 additional information was obtained from the growers as to number of seconds graded out per 100 bushels, the price received, method of selling, distance to market and amount of time required by each grower in marketing. When this material is analyzed

and the average price per bushel is combined with the average cost of production, it will give the net price per bushel to the grower.

In determining the best policy to follow in recommending further development of potato markets in New Hampshire, the advantages or disadvantages in production and marketing need to be balanced with one another. A comparison of potato production costs in different sections of the state has already been made and published in Station Bulletin 239. The present investigation will round out the picture of the potato industry in New Hampshire. (*Purnell Fund*)

Temperature Affects Potato Diseases

That temperature is to a large degree responsible for the difference in behavior of potato diseases in northern and southern New Hampshire is indicated by greenhouse experiments conducted by O. Butler.

Healthy plants and plants affected with mosaic and leaf roll are grown in one case at a mean temperature approximating very closely that of the certified-seed producing area of the state, and in the other case at a mean temperature approximating that of southern New Hampshire.

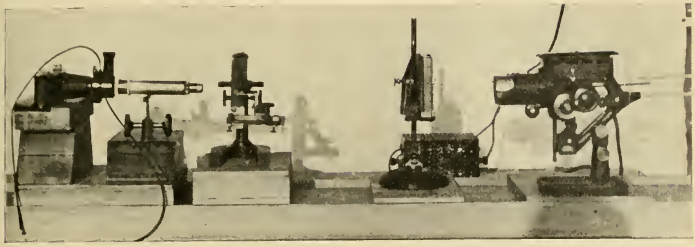
As was to be expected the mosaic plants grown at the higher temperature showed only mild or obscure symptoms of disease, while those at the lower temperature were conspicuously affected. The leaf roll plants showed the symptoms characteristic of this malady better at the low than the high temperature. The healthy stock grown at the lower temperature were much finer and thriftier plants than those grown at the higher temperature, behaving in this respect much like plants grown in the field under similar temperatures.

The mean number of tubers per plant was not affected by the temperature, and the yield of the mosaic and leaf roll plants was better at the higher temperature—results which the condition of the plants during growth would have led one to expect. The healthy plants yielded better when grown at the low temperature, and this despite the fact that the sprouts were slower coming through the ground. In other words the growth of the crop is faster at low than high temperatures.

Burgundy Mixtures Studied

Foliage is scorched when the proportion of copper sulphate to sodium carbonate (crys) in one per cent Burgundy mixture is reduced to as low as 1:0.5, finds O. Butler. Mixtures of 1:1 and 1:1.5 produced no injury on beans, whether exposed to the weather or protected, while a mixture of 1:1.84 caused very slight damage. With apples, increasing the amount of sodium carbonate delayed the appearance of injury, though eventually the total amount of damage was much the same for all mixtures except the most injurious one, 1:0.5.

Experiments on the prevention of deterioration of Burgundy mixture have been continued. A one-per-cent 1:1 mixture, which is acid when first made and becomes neutral on standing in an open vessel, and the copper precipitate, dense and heavy, may be preserved indefinitely by citric and tartaric acids, the experiments so far carried out indicating that the former is probably to be preferred.



Apparatus used for photographing drops of spray material in the study of contact insecticides.

How Contact Insecticides Work

How contact sprays kill insects is partly explained by recent studies of W. C. O'Kane, W. A. Westgate, L. C. Glover, and P. R. Lowry.

The surface activity of certain insecticides suspended or diluted in the droplets of water was found to influence the power of the spray to kill. Toxicity was found to depend partly on the ease with which the spray enters the breathing system of the insect.

Series of related chemical compounds, or different dilutions of one compound, were found to vary in toxicity according to the surface activity of the spray. Fatty acids, esters, alcohols, and phenols were included in the studies. The contact performance of the different compounds was determined from measurements of surface tension, and the angle of contact formed by the droplets of the spray on the body of an insect.

The purpose of the experiments is to learn how contact insecticides act—information which it is expected will play an important part in the future development of better sprays. The station published a report of progress during the year as Technical Bulletin 39.

Pine Thinnings Measured

Thinnings in white pine stands between 30 and 50 years of age can easily amount to a cord per acre per annum, finds K. W. Woodward. The stands are fully stocked. Most of the material removed goes into fence posts and cordwood.

In plantations now 10 to 15 years old of different species, red pine seems to be making, next to white pine, the most satisfactory growth. (*Hatch Fund*)

Study of Wholesale-Milk Farms

About 300 of the 414 wholesale-milk farms surveyed in Grafton and Coos counties under the direction of M. Gale Eastman averaged a labor income of less than $300, according to preliminary figures. The farmer with the lowest labor income was statistically "in the hole" $4,000, while the most fortunate farmer was $7,000 to the good.

The average farmer used farm products in his home valued at more

than $600 at present prices. This figure included his saving on house rent and on wood for fuel.

About one-third of the farms had central heating plants in the houses and milking machines in the barns, and a greater number had bath rooms, flush toilets, hot water and electric lights in the home, and trucks for transportation of farm products. Over half had oil stoves for cooking and two-thirds had radios and refrigerators. Two farms out of three had automobiles. Nine-tenths had running water for both house and barn and this was supplied to six out of every ten by gravity.

Four hundred and four of the farms maintained a total of 1,124 horses, or 2.8 horses per farm. The average age of each horse was 13.7 years. The majority of them ranged from 7.6 years of age to 20.8 years. Thirteen averaged 2.7 years of age and 34 more than 25 years old. Only 233 averaged less than 12 years.

The farmers interviewed for this study lived in the towns of Lebanon, Enfield, Hanover, Canaan, Lyme, Orford, Piermont, Haverhill, Bath, Landaff, Monroe, Lyman, Lisbon, Franconia, Littleton, and Bethlehem in Grafton county and in Dalton in Coos county. With few exceptions the major enterprise on these farms was the sale of whole milk to local milk stations supplying the Boston market. (*Purnell Fund*)

Poultry Farm Study

The average flock of Rhode-Island-Red pullets produces big marketable eggs after reaching the age of 50 weeks, according to a detailed study of management and financial records on 26 commercial poultry farms in southern New Hampshire. Frank Reed had charge of the investigation.

Twenty-two flocks of Rhode-Island-Red pullets were covered by the study. The pullets in each flock were of uniform age. A sample of 100 eggs was taken from each flock at weekly intervals and each egg was weighed individually. The 50th week practically all the eggs had reached their maximum size, 82 per cent of them averaging 24 ounces or more per dozen and 18 per cent 20 to 23 per dozen.

On the basis of egg size alone and not considering other factors, the advantage of early hatching is evident. January-hatched Red pullets should begin laying maximum-sized eggs in November or December and February pullets in December or January while May pullets would not be laying large eggs until the next March or April.

Eighty-seven per cent of the eggs from the three best flocks weighed 24 or more ounces per dozen when the pullets were 50 weeks of age, while only 61.7 per cent of the eggs from the three poorest flocks carried that weight. The number of 24-ounce eggs from the best flocks was 14 to 24 per cent greater during the whole period. (*Purnell Fund*)

Poultry Thrives on Cafeteria System

Left to themselves in a pen with a hopper full of grain and a hopper full of mash, chickens will pick and choose what their needs require, and not grow over-fat, a fact which is contrary to a popular belief of poultrymen. This was learned from a series of feeding tests conducted by T. B. Charles and H. O. Stuart.

In one experiment four pens, each containing more than a hundred birds, were used. Two pens were hand-fed grain and two were given their grain in hoppers. It was found that the birds were able to adjust their feed intake to their individual requirements whether they had continuous access to grain in hoppers or were restricted to a short feeding period in the late afternoon.

Under both conditions the birds consumed about 48 per cent of their total feed in the form of mash over the full feeding period of 37 weeks. In the separate weeks of the experiment, however, wide variations occurred. The proportion of mash to scratch feed consumed, ranged as widely as from 39 to 65 per cent, indicating that fluctuations depend on the rate of production and the environment of the birds. It is doubtful whether a poultryman, by the hand-feeding method, can judge the requirements of the hens as accurately as the birds themselves. Birds in all pens made consistent gains in body weight and finished the 37 weeks in the experimental pens in a good marketable condition.

Carrying this experiment a step further, Messrs. Charles and Tepper studied whether birds would establish a balanced ration of their own from hoppers of individual feed ingredients. Two pens of 100 birds each were used. In one pen the regular New Hampshire laying ration was fed; in the other, each ingredient was supplied in an individual hanging hopper. At the end of 12 weeks considerable variations in the percentages of certain feeds were found. The birds in the cafeteria pen, for instance, chose much more corn meal and less whole corn, more whole wheat and less bran than those given the standard ration. Even with these differences, however, there was not a wide variance between the two nutritive ratios. In the cafeteria group this ratio based on the proportionate consumption of mash and scratch was 1:4.98, and in the control group 1:4.82. There was a slight loss in weight, amounting to .299 pounds per bird. The feed cost in the cafeteria group was 3.12 cents more per bird for the 12-weeks period.

While birds can apparently be trusted to feed themselves carefully on grain, another experiment indicates that care must be taken to provide only a reasonable amount of any succulent supplementary feed to laying birds.

Two groups of S. C. W. Leghorns fed an abundance of mangel beets were thrown out of condition physically and production was materially reduced. These birds were slow to respond to corrective treatment. There was a shrinking of the comb and wattles and the comb, particularly, took on a purplish cast. Many of the birds indicated by their appearance a general upset physically. The majority molted, but some were able to continue production. Apparently any appetizing succulent material can easily be fed in sufficient quantities to affect the physical condition of the birds adversely, and in many cases upset production.

Other Poultry Studies

Vitamin A Requirements of Chicks. Varying levels of cod liver oil were fed in addition to a basal ration otherwise deficient in vitamin A. An ultra-violet lamp was used to irradiate the chicks daily in order to be sure of sufficient vitamin D. The results reported by H. O. Stuart indicate that a ration should have other sources of vitamin A in addition to that supplied by the usual amount of cod-liver oil. These groups showed marked kidney injury and microscopic examination of the manure indicated vitamin-A deficiency.

Control groups fed only the basal ration without cod liver oil showed no retardation effect in their growth by the deficiency of vitamin A. No symptoms of vitamin-A deficiency were observed in a reserve group fed the normal ration. (*Purnell Fund*)

Trials of Irradiated Substances. Three groups of 60 chicks each were fed rations containing one-fourth per cent of irradiated yeast, one-half per cent and one per cent of irradiated ergosterol respectively. Growth was deemed satisfactory under the conditions, and rickets was not observed in any of the groups, reports H. O. Stuart. The irradiated ergosterol was diluted with corn oil to the recommended standardization in potency approximating cod-liver oil and computations made on that basis. (*State*)

Rapid Feathering Helped to Prevent Bare Backs. With previous data on the subject used as a basis, a breeding pen of rapid-feathering birds was selected by H. O. Stuart and T. B. Charles to compare with slow-feathering strains. Chicks hatched from the former were particularly well feathered before reaching broiler age, whereas a large percentage of bare-back broilers was noticeable from the latter under the same conditions of brooding. (*Purnell*)

Temperatures in Battery Brooding. During the first part of the brooding season H. O. Stuart and T. B. Charles noticed that a high percentage of chickens developed a slipped-ligament condition of the hock under a high-brooding temperature. Subsequent groups brooded under identical conditions other than a reduction in temperature were affected in only a slight percentage of the chicks. This indicates that too high a battery-brooder temperature during the first few weeks may be a contributing factor in the development of this abnormality. (*State*)

Control of Cannibalism. Pine boughs, supplied daily to two pens of 200 birds each, proved effective in controlling an outbreak of cannibalism. H. O. Stuart and T. B. Charles report that other factors which may be of assistance are tipping beaks, removing individual cannibalistic birds, supplying green food, supplying fresh meat for consumption, darkening nests and house, keeping the birds active by more frequent feeding, meat scrap placed in an open hopper, and condensed milk feeding. (*State*)

Certification of Poultry

Certification of poultry is increasing rapidly in New Hampshire. The first year, July, 1927, to July, 1928, approximately 26,000 birds were handled. The number jumped to approximately 40,000 the next two years and will probably exceed that number this season.

The certification work, which is done at a charge of three cents per bird to partly cover the expense, separates hens into three classes, depending on their ability to produce chicks having the qualities for high egg production and conformance to specific standards. The first class includes only those with good egg-production characteristics which are free from the various disqualifications and are to be used as breeders. The second class consists of those with lower egg-production characteristics, less desirable color, and such disqualifications as side sprigs, feathers or stubs on shanks or feet, comb foreign to breed, off-color ear lobes. Those in the third class are culls unfit for profitable egg production.

This service is available only for flocks in the process of being accredited free from pullorum disease or flocks already accredited. (*Miscellaneous Income.*)

Post-Mortem Examinations

This chicken became paralyzed at the age of 77 days. Autopsy showed coccidiosis. The poultry pathology laboratory conducted 1,600 post-mortem examinations of chickens during the past year.

Post-mortem examinations of chickens at the poultry pathology laboratory numbered 1,660 and showed that pneumonia and pullorum disease caused the greatest loss of chicks and coccidiosis the largest fatality among hens.

The extent of the losses of chicks, due to various diseases and other causes, is as follows: pneumonia, 277; pullorum disease 266; coccidiosis 62; B. coli infection, colds, indigestion, enteritis, and eight other difficulties, 113.

Autopsies of hens showed the following results: coccidiosis 268; round-worm infestation 76; ruptured egg yolk 71; pneumonia 53; pullorum disease 51; tape-worm infestation 42; fine sand in intestinal tract 36; chronic coccidiosis 27; no diagnosis 23; stalphlococcus infection, sour crop, paralysis, and 25 other troubles, 228.

Of the 38 turkeys examined 11 died of blackhead, 10 of pneumonia, 8 of pullorum disease, and the remainder of other troubles. In flocks of turkey poults affected with pullorum disease in New Hampshire this past season, losses ranged from 20 to 90 per cent. A breeding flock of 122 birds showed a positive reaction to the disease of 36 per cent. Twenty-nine per cent reacted suspiciously.

An intestinal worm called Capillaria was found for the first time in a few poultry flocks, but is not expected to cause much trouble. The post-mortem work was done by C. L. Martin and C. A. Bottorff. (*Miscellaneous Income*)

Pullorum Disease Decreases Markedly

The amount of pullorum disease in New Hampshire poultry flocks has decreased markedly in the 13 years that testing has been in progress. In the years before the testing began many poultrymen reported

losses as high as 60 per cent of all chicks hatched. This had dropped to around eight per cent in a year or two after testing was underway. In the last three years the infection in the thousands of birds tested has fallen from approximately three per cent to less than one-half of one per cent.

In the past season 150,416 birds in 164 flocks were tested. What was thought to be the "peak" in this work was reached in the years from 1923 to 1925 when 40,000 birds were tested annually. The statement was made at the time that it seemed probable "that from now on approximately 25,000 to 30,000 birds will be tested annually."

The prophecy was entirely wrong. Seventy thousand birds were tested in 1927, practically 80,000 the next year, virtually 125,000 in 1929, and 150,000 in 1930. Four thousand birds were tested when the work began in 1918.

Over 72,000 birds comprising 62 flocks are now on the accredited list. The figures in 1928 were 54 flocks and 36,330 birds. The flocks then averaged 675 birds apiece; now the average is approximately 1,175.

During the past season only 18 per cent of the flocks were found infected as compared to 27 per cent the previous season. The majority of these were flocks tested for the first time. One hundred per cent of the birds in 143 flocks were tested and 119 of these passed one or more clean tests. No reactors were found in 15 flocks in which only part of each flock was tested. Eight new flocks were added to the accredited list after having passed the second 100-per-cent clean test. (*Miscellaneous Income*)

Rapid Eradication of Pullorum Disease. The most rapid way to eradicate pullorum disease from a poultry flock is to save only the birds which test absolutely negative to the "rapid serum" method of agglutination testing, according to investigations made by C. A. Bottorff. While this method may reduce the size of a flock 25 to 30 per cent, one would still have enough breeding stock to build the flock to its original size the following season.

In this work a flock of 769 birds with 13 original reactors was tested at monthly intervals until two clean tests were obtained the third and fourth months. To prove the success of the method a retest was made at the end of 10 months and another at the end of 16 months, the flock ranking 100 per cent clean each time.

In none of the tests were birds saved that showed the slightest trace of an agglutination.

The flock was reduced to 592 birds following the first retest, with seven of those removed showing a strong reaction. The second retest cut the flock to 561 birds. Only two definite reactors were included among the birds removed and no birds following the third and fourth retests which were both negative. All tests were checked by the standard-tube method. (*Miscellaneous Income*)

How Pullorum Disease May Spread. Pullorum disease was shown in an experiment conducted by C. A. Bottorff to have spread rapidly from a group of infected birds to clean birds that ranged with them.

After the two groups had been together for one month the infection had spread to one per cent of the clean group; by two and one-half

months the infection in the clean group was increased to three per cent. Two months later this had reached four per cent.

An even greater spread was observed in the infected group, which showed a nine-per-cent infection at the beginning of the experiment. One month later this infection spread to 20 per cent of the group. The next one and one-half months resulted in a gain of only three per cent, with no additional spread two months later. (*Purnell Fund*)

New Way to Vaccinate for Fowl Pox

A new way of vaccinating poultry to prevent fowl pox has been tested on New Hampshire farms during the last two years by C. L. Martin and C. A. Bottorff and found superior to the older "follicle" procedure. Known as the Johnson stick method, it is reported quicker and easier, more economical on vaccine, equally efficient, and the cause of fewer head lesions.

Further investigations were made with the assistance of A. E. Tepper as to the length of incision necessary for a good "take" and the best type of vehicle to carry vaccine. As to the latter no difference was found in a combination of sterile glycerine and distilled water, and distilled water alone. Three types of incisions were tried—a stab, one-eighth inch incision, and one-fourth inch incision—and all proved equally good. (*Purnell*)

Poultrymen representing 28 flocks in New Hampshire received 40,250 doses of fowl-pox vaccine. Most of these men were located in the southern end of the state. The vaccine was also distributed under federal permit to poultrymen in other states, as follows: Massachusetts, 26,400 doses; New Jersey 10,075; Pennsylvania, 2,200; New York, 1,500; Rhode Island 756; Maine 300; Vermont 50. (*Miscellaneous Income*)

Contagious Abortion

In a study of the control and eradication of contagious abortion of cattle by means of the standard agglutination test, blood samples have been collected at frequent intervals from seven experimental herds near Durham. The work has shown that this disease can be handled by the blood test, coupled with a practical plan of sanitation and isolation of each of the groups of negative, positive, and suspicious reactors. C. L. Martin is in charge.

Herd No. 1 has remained clean since the last reactors were sold in 1926. Herd No. 2 has remained clean since reactors were removed in 1928. Herd No. 3 has had one suspicious reactor since the last was removed in 1928. Two reactors were brought back to herd No. 4 which had been isolated and they started abortions in the others, increasing the number of reactors from none to six positive and six suspicious out of 32 head in a period of six months.

Herd No. 5 was divided into positive and negative groups in the same stable but pastured in different pastures. By observing good sanitation and replacing reactors with non-reacting heifers, the herd has changed since 1929 from eight positive, nine suspicious, and six negative to four positive, four suspicious, and 18 negative. No division was

made between positive and negative animals in herd No. 6 and consequently the disease spread very rapidly. Positive and negative animals in herd No. 7 were placed in two different stables, with the result that the number of positive reactors is gradually decreasing because the reactors are being replaced by the non-reacting heifers they raise.

Some animals were observed to maintain a natural agglutination indicating suspicious reaction. In one instance a dam and two daughters held to this condition, indicating the possibility of this being a family trait in their case. (*Purnell*)

Further research on contagious abortion by Mr. Martin gave results contrary to reports of other investigators which state that reactors fail to respond to the agglutination test if neutral acriflavin, an aniline dye solution, is injected into their blood stream. Two strongly positive reactors were treated with this solution by Dr. Martin, but continued to show positive reaction to tests covering a period of two months. (*Miscellaneous Income*)

Increased interest has been shown in the blood test as a means of controlling and eradicating contagious abortion of cattle. Blood samples tested at the pathology laboratory numbered 3,451 this year, as compared to 841 a year ago. Of the animals tested 17.8 per cent were found infested. The samples were submitted to C. L. Martin by veterinarians in the field. (*Miscellaneous Income*)

Treatment of Large Animals

Large animals treated by C. L. Martin included 26 cattle, 62 horses, 34 hogs, and 37 sheep. These were from the stock of the college of agriculture; veterinarians in the field also sent in specimens. (*Miscellaneous Income*)

Inspection Service

Feeding Stuffs Inspection. In the enforcement of the law regulating the sale of concentrated commercial feeding stuffs, 351 brands requiring 2,900 individual determinations were analyzed for the State Department of Agriculture.

Fertilizer Inspection. One hundred and seventeen brands of commercial fertilizers were analyzed for the State Department of Agriculture. These required about 800 individual determinations.

Miscellaneous Analyses. Samples of soils, feeds, fertilizers, liming material, leaf molds, poisons, etc., have been sent in by residents of the state and by departments of the college of agriculture, and of these 187 were analyzed. About 250 individual determinations were necessary.

Seed Inspection. During 1930, 410 samples of seed were handled in the laboratory for the State Department of Agriculture. Of these 375 were collected by the state inspector. The remaining 35 were private samples.

Potato Seed Certification. Forty-eight acres of Green Mountain potatoes were entered for certification in 1929, 19 of them failing to meet requirements at the first inspection and five being withdrawn before the second inspection.

Advanced Registry Tests. Short-time and yearly advanced register tests were handled during the year, July 1, 1929, to June 1, 1930, as follows: Holstein—semi-official, 96 cows; herd test, 88 cows; seven-day, 22 cows; total, 206 cows. Jersey—register of merit, 21 cows. Ayrshire—roll of honor, 1 cow; herd test, 137 cows. Guernsey—advanced register, 180 cows. Shorthorn—yearly, 44 cows. Check tests —various breeds, 40 cows. (*Miscellaneous Income*)

Financial Statement

Expenditures of the New Hampshire Agricultural Experiment Station for the Year Ending June 30, 1930

	HATCH FUND	ADAMS FUND	PURNELL FUND	SUPPLEMENTARY*	TOTAL
Salaries	$9,180.16	$11,723.75	$42,977.53	$19,212.00	$83,093.44
Labor	896.44	630.10	3,607.83	4,531.31	9,665.68
Stationery and office supplies	637.05	13.07	330.59	333.63	1,314.34
Scientific supplies, consumable	82.56	311.90	920.01	1,591.72	2,906.19
Feeding stuffs	.....	500.92	744.50	595.69	1,841.11
Sundry supplies	260.51	41.00	690.48	2,127.97	3,119.96
Fertilizers	106.05	24.50	308.64	334.51	773.70
Communication service	251.81	1.92	36.88	99.12	389.73
Travel expenses	527.70	117.77	5,424.74	5,089.76	11,159.97
Transportation of things	327.69	22.12	349.26	288.59	987.66
Publications	1,226.69	.....	1,117.39	537.74	2,881.82
Heat, light, water, and power	700.00	.....	.22	21.13	721.35
Furniture, furnishings, fixtures	12.36	423.49	1,041.65	145.53	1,623.03
Library	564.10	.....	21.75	364.83	950.68
Scientific equipment	207.39	509.53	1,351.02	1,039.65	3,107.59
Livestock	.....	.....	193.00	76.50	269.50
Tools, machinery and appliances	3.39	127.46	465.46	1,884.03	2,480.34
Buildings and land	7.00	552.47	307.54	208.88	1,075.89
Contingent expenses	9.10	.....	111.51	571.49	692.10
Unexpended balance	.....	.....	.....	10,084.26	10,084.26
TOTALS	$15,000.00	$15,000.00	$60,000.00	$49,138.34	$139,138.34

*This fund includes expenditures from the following sources:

State appropriations	$ 5,500.00
Sales and miscellaneous income	43,638.34
	$49,138.34

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